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ABSTRACT

This paper compares and contrasts the Internet with other fundamental educational infrastructures throughout history by assessing the affordances and constraints of that medium along with those of oral tradition and print literacy. Highlights include affordances and constraints of the Internet; literacy and the development of education in the Medieval-to-Modern and Modern-to-Postmodern periods and the resulting focus on the learning process, constructivism, and skills development; interactivity of Internet learning materials; a comparison of the Internet to libraries and the publishing infrastructure; and the shifting role of the online user in assessing and even controlling the quality of materials, responsibilities which were previously left to editors and professionals. (Contains 44 references.) (AEF)

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Title:

Affordances and Constraints of the Internet for Learning and Instruction

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Abstract

The Internet promises dramatic changes in the way we learn and teach, the way we interact as a society. The changes of a coming epoch are already taking shape. In higher education, most students have access to Internet resources. But many who have access have shown reluctance to make use of those resources. An attempt to understand this reluctance has led to an analysis using James Gibson's model of affordances. This paper contrasts the Internet with other fundamental educational infrastructures throughout history. It offers an analysis of literacy, printing and electronic publishing in terms of human affordances along with the constraints associated with each medium.

Affordances and Constraints of the Internet

The history of Education cannot be told apart from its technology. From orality to literacy, from manuscripts to the printed page, from text to hypertext, the prevailing technologies supporting education have defined its very nature. Stopping short of technological determinism, we acknowledge the chicken-and-egg relationship between technology, education, and society. The possibilities which education brings to society depend upon the affordances of the undergirding technology.

We use the term affordance to describe a potential for action, the perceived capacity of an object to enable the assertive will of the actor. The term was coined by psychologist James Gibson (1977) to describe the action possibilities posed by objects in the real world. There are many objects in our environment. Some we ignore, some we adapt to, and some we appropriate for our assertive will. It is the objects in this last category which fall under the the definition of affordances. Certain objects afford opportunities for action. An affordance is a value-rich ecological object that is understood by direct perception. Perception informs the individual of affordances. Action transforms affordances into effectivities which extend human capabilities (Allen and Otto, 1995). Our own bodies are affordances. The eyes afford perception, the ears listening, the hands manipulation, the tongue and vocal cords afford utterances (Jonassen, Campbell and Davidson, 1994). Natural affordances emerge into effectivities through use in conscious activity. The hand of an infant, though attached, is a separate object. The infant is amused by it, studies it, tastes it, touches other things with it. Soon the infant learns to use the hand to manipulate other objects. In the process, the hand gradually transforms its object-ness to subject-ness. The child becomes less conscious of the hand as she uses it as an extension of her own intentioned will. The affordance becomes an effectivity.

Technology and media are affordances to the extent that they promise extended human capabilities of seeing, hearing, and uttering. Tools are affordances to the extent they offer extended human capabilities for manipulating things in the environment. (Rasmussen, et. al., 1994). Through use, skill is acquired and the object becomes an extension of ourselves (McCluhan, 1964). These artifacts are transformed from affordances to effectivities.

Literacy

Five thousand years ago the affordances of orality and rhetoric were extended by the technology of written text. Writing enabled the precision of recorded memory. It afforded cognitive communication across time and distance. Literacy gave birth to History. The written word introduced constraints of grammar and syntax, but out of these constraints emerged stability and permanence of language. It was a means of representing and archiving human knowledge for later retrieval by one's self or by another.

We look at antiquity through the eyes of those who could read and write, shading, perhaps, our view of the importance of literacy in shaping history. When we think of antiquity, Athens invariably comes to mind. Athens was among the few ancient cultures that valued literacy. Athens provided a system of public education which included reading and writing, an affordance we take for granted today. But, just as it is today, not all Athenians chose to appropriate skills of literacy. Athens produced history's most famous illiterate, Socrates, who opposed the technology of writing on the grounds that it would corrupt the human mind and destroy the memory of mankind (Plato, 360 BCE). We suggest, from the standpoint of affordance, that Socrates perceived no need to write. After all, he had his graduate students, Xenophon and Plato, to record his words for him(1). But more fundamentally the assertive will of Socrates found its full potential within the affordance of oral discourse and dialog. Writing, to Socrates, was an aimless diversion. Indeed, for most of written

history, writing was not an affordance for the common person. For centuries, it was the exclusive realm of the power elite.

The manuscript was an instrument of power. The written word is a permanent record, an objective archive, a sense of authority. Manuscripts were guarded, protected and generally inaccessible (Mukerji and Jones, 1995). For thousands of years, written knowledge was the affordance of the literate few: the priests and princes who controlled access to manuscripts and who had the skills to make use of the technology. Those who controlled knowledge controlled the collective conscience, the laws, the social structures, and the tax records. Literacy was the means of social control.

Medieval to Modern

In the period approaching the late Middle Ages, the power of literacy began to spread to the merchant class. Universities emerged in the thirteenth century, before the age of Gutenberg. Manuscripts were extremely costly, reproduction of a single copy required weeks of labor by an established member of the literati (Eisenstein, 1983). Often, students copied their own texts, transcribing oral recitations by a lecturer/reader(2). Learning to read and write was the privilege of an elite few. For those without means, a literate education was characterized by extreme effort supported only by primitive techniques and rudimentary tools(3). Entry into the literate community was not possible without great personal sacrifice (Cantor, 1969). Manuscripts, the objects that enabled this intention, were affordances for acquiring literacy.

The rise of the universities in Europe and the neo-classicism associated with the return of the Crusaders in the thirteenth century drove unprecedented demands on manuscript production. In a previous era, this renaissance would die before it began, lacking the infrastructure to support the propagation of knowledge. But modern technology was on the horizon. The mid fifteenth century saw the convergence of several unrelated developments: the wine press, paper production, oil-based ink, block printing, and finally, movable type. (Mukerji and Jones, 1995). On a spring morning in 1452, the headlines declared, "The Scribe is Dead. Long Live the Printer!" Print technology was soon to become the affordance of an aspiring middle class.

The modern age arrived with the first edition of Gutenberg's Bible. The cost of book production fell by several hundred fold. A printer could reproduce a thousand copies of a book in the time it took a scribe to reproduce four copies of the same text. Within a few years there were more circulated copies of Scripture and the major classics than had existed previously for all time. In the coming years, the Scriptures and the classics became affordances, not for spiritual ends, but as a means of learning how to read and write, as a means of mastering reason, logic and rhetoric (McCluhan, 1962). By 1501, there were a thousand print shops throughout Europe. They had produced two million copies of texts, 35,000 titles (Mukerji and Jones, 1995).

The affordance of archived knowledge burst free from the constrictive grip of monks, priests and courtiers. The power of print technology was in the hands of an emerging ruling class. The printing press was an affordance for Martin Luther to assert his Ninety-five Theses, challenging established authority. The emerging years brought the Reformation, the Enlightenment and democracy. The bourgeois state triumphed over monarchies. Liberalism instituted basic rights and freedoms: The rights of private property, freedom of self-expression, and freedom of the press. These "self-evident" rights spread throughout the Western world. They were the expressed freedoms for all citizens, but they were particular effectivities for those who owned property, those who possessed the skills associated with self expression, and those who owned or controlled the presses (Bagdikian, 1993).

The modern age became an age of reading and writing (mostly reading). Book learning changed the nature of basic education throughout the West. The providers of education (initially the church, and ultimately the state) perceived it as an institutional affordance to foster morality, patriotism and citizenship. Education itself was primarily moral (the intention of the institution) and secondarily intellectual (the intention of the learner). Educational technologies (the textbooks, the lessons, the methods) were designed to carry out the primary intention. The Massachusetts law of 1647 made its intentions explicit: to disable the "project of that old deluder Satan to keep men from the knowledge of the Scriptures" (Massachusetts School Law, 1647). Doctrinal intentions prevailed for over two hundred years in American Schools. Instructional technology reflected those intentions. The hornbook was designed to teach basic reading, but more importantly, Christian doctrine. This technology was a wooden frame on a handle. The frame enclosed a single printed page containing the English alphabet followed by the text of the Lord's Prayer. The New England Primer was

characterized by heavy religious platitudes: "In Adam's Fall We sinned all." "The idle Fool Is whipt at School," etc.. Noah Webster's Blueback Speller offered short parables with morals explicitly interpreted on each page. From 1836 to 1907 the McGuffy Readers set the standard for American grammar school education. There is rarely a page in that series of six readers which does not address itself to some moral problem from the standpoint of Protestant Christianity and Victorian ethics. The six books propagated a middle-class, conventional, paternalistic morality, reflecting the values of the dominant culture (Commanger, H.S., 1962). Education molded the collective conscience. Literacy was a means for social control.

Education in the twentieth century retains a content-centered paradigm of institutional affordance (Lemke, 1994). However, this has been a century of major curricular reforms. The changes have reflected a more diverse and complex society with a broader range of values and priorities. As our society continues to diversify, as the need for technical skill increases, as the world changes faster than textbooks and lesson plans can keep pace, the emphasis on curriculum content is giving way to a focus on the learning process. Constructivism, considered radicalism a decade ago, is the dominant perspective at most educational conferences. Content objectives are giving way to a focus on skills development, instructional designs are giving way to learning environments where students define the central tasks, including how the learning should be monitored, assessed and adjusted to achieve the desired outcomes. Such strategies bring flexibility to the educational process, adjusting to continued change in a postmodern world.

Modern to Postmodern

The term postmodern is often over-used and ill-defined. But we can't come up with a better term to describe the transitions taking place today in educational technology. What's the difference between modern and postmodern? A telling illustration comes from Alluquere Rosanne Stone (1995). Stone describes an encounter between former quiz kid Charles Van Doren and computer interface creator, Brenda Laurel. The encounter took place at Atari Labs in the late 1980s where Dr. Laurel was engaged in research on interactivity. Van Doren was working for the Encyclopedia Britannica company which had begun work on a new interactive version on CD ROM. Stone describes the story:

> He came by Laurel's new office in the lab one day and proceeded to chat her up about interactivity. Laurel's ears perked up. "That's great," she said, "I'm working on interactivity too."
>
> "You are?" Van Doren said.
>
> "Sure," Laurel said enthusiastically. "I've got this idea for an interactive educational thing about whales told from multiple perspectives - whales from an Inuit perspective and then whales from a whaling corporation perspective, and a Greenpeace perspective, say. Multiple narrative thread, user selectable. It'd fit right into your interactive encyclopedia."
>
> Van Doren turned red and began to make a peculiar noise. After a few seconds laurel realized he was sputtering. Finally he burst into speech. "Encyclopedias don't present viewpoints," he said, biting off the words. "Encyclopedias present truth."

This encounter is a vivid contrast between modern and postmodern thinking. The modernist presents the truth, just as it was nailed on the door at the church of Wittenburg in 1557; just as it was introduced to American children in six complete volumes for most of the 19th Century, just as it was represented on the 1950s television quiz show "the 64,000 Question". The postmodernist offers multiple perspectives from a complex world, including, perhaps, the modernist conception of truth (Wilson, 1994).

Today's information technology enables the transition from modern to postmodern, no less than the printing press enabled the transition from pre-modern. How many days would it take a scribe to provide us with a copy of Aristotle's Rhetoric? Seven days? Fifteen days? Thirty days? And what is the cost of skilled labor? $10/hr? $15/hr? $25/hr? At the

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most conservative estimate, the manuscript would cost more than $500. But the modern printing press makes it available for less than $10. And postmodern electronic publishing provides it at virtually no cost! Our computer in Denver is connected via the Internet to a computer at Virginia Tech, where the complete works of Aristotle reside on a rotating magnetic disk. We can download Rhetoric instantly, at no charge.

But is it really free? There must be a cost associated.

There is a cost associated with disk data storage. With current technology, the cost is about fifty cents per megabyte. To store Aristotle's Rhetoric (400 KB), the cost is about twenty cents.

At such a bargain, why don't I store it on my own disk? The answer is, I don't need to. I can get it anytime I want from Virginia Tech (or one of the forty some other Internet sites that have it!) What's more, I can link it (as we have done above) to my own writing. To the extent that such capability serves our intended purpose, the link is an affordance for us, the authors. To the extent that the link serves the reader's intentions (regardless of our intentions), the link is an affordance for the reader.

Our point is that technology has changed the way we consider content. In a 14th century university classroom, a manuscript of Rhetoric was likely the exclusive source of information. That was a constraint imposed by the technology. Today, we can download Rhetoric in seconds, but we can also download related texts, commentaries, research studies, historical perspectives, ad infinitum. We can scan these texts with the eye of a computer, discovering patterns, linking them to allied texts, offering multiple dimensions of textual analysis (Olsen, 1993) (Landow, 1994).

Interactivity

In recent years, a prime objective in media development has been the quality of interactivity. This has been especially true with educational media, starting in the 1950s with Skinner's "teaching machine", evolving in the '70s to "response-and-branch" CBT, progressing into the '80s with Apple's "poke-and-see" hypercard and ultimately, "answer-vision", the hopes behind interactive video. All of these are examples of closed systems in which the content is pre-defined, responses are anticipated, and action is controlled by the designer alone. Interactive video pioneer, Andy Lippmann, lamented the inherent weakness of such closed systems. None seemed to satisfy his definition of interactivity, the mutual, autonomous, and simultaneous activity of both participants working toward a common goal. Lippman suggested five criteria which are necessary to satisfy this definition: (Brand, 1987) (Stone, 1995)

- interruptability, the ability of either participant to interrupt the other at any point.
- graceful degradation, the ability to set aside the unanswerable questions in a way that does not halt the conversation.
- limited look-ahead, the quality that makes it impossible to predict the ultimate outcome of a conversation by either party.
- no default, a quality which allows the shape of a conversation to develop naturally, organically, without a preplanned path.
- the impression of an infinite database, the quality of limitless choices and realistic responses to any possible input.

Lippman's criteria are fundamentally unreachable under the constraints of a closed technology. But the open architecture of the Internet transfers interactivity from an affordance of designer control to that of user control. From flat textual domains to full motion video, the Internet transforms the mechanistic character of modern media into a postmodern phenomenon, shifting agency from author to user. The designer has lost control (Kelly, 1995), but the medium has gained credibility. We no longer have to contrive interactive "lessons" and exercises. The real world is waiting on the other side of the terminal.

When we speak of affordances in the study of media, we are cautioned as designers to resist the assumption that a given medium affords a specific set of learning outcomes. In reality, learning is distributed between the medium, the learner and the context (Jonassen, Campbell & Davidson, 1994). There is nothing inherent in the Internet that guarantees learning.

But in a specific context involving learning activities, such as research, collaboration, self expression, and reflection, the Internet offers multiple affordances, so numerous that it may be a mistake for us to treat it as a medium. It is really an infrastructure which brings together media, tools, people, places and information, expanding the range of human capabilities.

If we treat the Internet as an infrastructure, then we can draw comparisons between the Internet and other infrastructures which society has come to rely upon for learning and education. These include:

* a library
* a publishing house
* a school
* a community
* a city
* (please add to this list)

We suggest that the Internet offers multiple affordances, not unlike other infrastructures for learning. And we suggest that the Internet overcomes significant factors which have historically constrained the others. A comparative analysis may illustrate our point.

Library

The library is an infrastructure containing multiple technologies working together to deliver specific information in response to an inquiry. The patron consults a data base (card catalog or electronic index) to find a range of books which may contain the desired information. The patron selects the most appropriate listings from among those suggested, then proceeds to the locations in the library directed by each selection. For each book that is located, the patron consults its index and table of contents, then leafs though the pages to confirm whether the book holds pertinent information. If so, the information is eventually extracted and the task is complete.

Research on the Internet involves a similar process. The user consults a database called a search engine. A simple or structured query will yield a set of hits or listings, not unlike the selections from a library catalog. The user selects the most appropriate hits, retrieving each document electronically. Within seconds each target document is retrieved. A hypertext index or table of contents will allow the user to dip into the text wherever her interest leads. For plain text documents, the user can invoke a keyword search utility on her browser locating specific paragraphs of interest. Pertinent information is extracted and the task is complete.

Like a library, the Internet affords great potential for research. The processes of information searching are similar, if not identical. The results are not so similar. At the present time, a good research library is likely to yield a higher quality result than the Internet. But the Internet is likely to yield more up-to-date information than a library.

A comparison of constraints will reveal some important differences:

Schedule

A library is constrained by limited hours of operation. Serious researchers are painfully familiar with the signification of flickering lights toward the end of the library's service day. But the Internet is not constrained by schedule. It is as available as a personal computer and a modem.

Location

A library has a fixed location. Most communities have at least one library but rural communities are especially constrained. The Internet is not constrained by proximity. It is accessible

anywhere that electronic communication is possible. Typically the electronic patron accesses Internet resource from home or from the work place.

Holdings

A library's holdings are constrained by past acquisitions and current budgets. Most libraries are able to overcome this constraint by interlibrary loans. The Internet is one huge virtual library whose holdings are growing daily. At the present time, resources on the Internet are fundamentally constrained by copyright. Most books in print are available in book stores or at the library, but they can not be obtained online. This is not a natural constraint of the technology, but the result of lagging proprietary laws associated with prior technologies (Lehman, 1994).

Another constraint, at least for the present, is laborpower: the effort required to migrate public domain literature to electronic substrates. This is a noble effort, motivating thousands of volunteer scribes (see Ryder, 1995), but at this moment the bulk of the world's literature remains somewhere on a dusty shelf.

Accessibility

A library book is accessible within minutes, hours, days or weeks, depending on the book's location and availability. Electronic texts are available instantly. Checked-out and overdue documents are unknown in the virtual library. Research sessions need not be interrupted for lack of immediate access. What's more, instantaneous retrieval enables hypertext (linking between texts) as a research affordance -- something not feasible with conventional print media.

Timeliness of holdings

Libraries receive information once it is published. Published information is usually well written, edited and thoroughly reviewed for accuracy. For most quality books, this process takes several months. New material finds its way to the Internet immediately. Many articles are accessible on the net months before they become published in print form. Authors often post early drafts of their work for purposes of feedback and peer review (Harnad, 1995). (This paper was accessible on the net as this very sentence was being drafted!)

The immediate overriding constraint of the Internet is the fact that few users have learned how to manipulate Internet tools with the same confidence that they can manipulate a library. As the Internet evolves, we can observe the changes before our eyes. In the past two years, the number of text objects on the World Wide Web grew from several thousand to several million. The tools for extracting information showed their limitations as Internet holdings constantly increased. New tools have been laid down over the old, smarter, faster, yielding more astounding results. Tools are evolving in the direction of object-oriented simplicity. But users are hard-pressed to keep up with the changes.

The implications for instruction and performance technology in this context are obvious. Most of us learned how to use the Library when we were in school, and we learned by doing -- doing research. In the process of solving research problems we had the scaffolding of librarians and the coaching of good teachers. We suggest that Internet skills deserve a similar treatment. The power of Internet resources remains latent to those without the skills to use them.

But who are the librarians in this virtual library? Who will provide the scaffolding and coaching for the unskilled researcher? Who will undertake the task of conjoining people and knowledge (Birchall and Randa, 1995)? Who will classify knowledge and information? These tasks don't go away in the virtual environment, but the agency of librarianship shifts from the center to the periphery. The role of virtual librarian is distributed. In the virtual library there is no central keeper of knowledge, only curators of particular views (Kelly, 1995). The role of organizing and classifying knowledge is passed to each user. A user saves and organizes the information that is personally useful. As one's interests and knowledge become specialized, a niche emerges for a specific field of knowledge. The ones who use the information are the ones who will organize and classify that body of knowledge, primarily for personal use but also to serve the virtual community. The intellectual labor invested in research is freely shared on the net as users make public the artifacts of their own knowledge construction: the bookmarks, lists and directories of information we compile for use in our own intellectual efforts. One person's artifact is another's affordance.

In my own work, I maintain a set of bookmarks related to Instructional Technology (see http://www.cudenver.edu/~mryder/itcon.html). While the work is a product of my own research for my own purposes, it can provide scaffolding for others with similar interests. By making public this entailment, I have the benefits of interaction with others who are drawn to the resource because of their own allied modes of inquiry. The ethic of sharing information, including classifications of this nature, is the emerging culture of the net. The motivation is no different than the traditional practice of publishing scholarly work.

Publishing

The publishing infrastructure has been the primary conduit for knowledge in the modern world. It requires capital and considerable labor to disseminate information in published form. Between the modern author and the reader is an infrastructure which includes editors, type setters, printers, binders, and a complex marketing and distribution organization. For a publisher to print anything today, a business case must guarantee proper return on the investment. At a time when society's need for diverse information expands geometrically, the number of corporations which control the publishing infrastructure continues to decline (Bagdikian, 1990). While freedom of the press is extended to all, its affordance is an exclusive privilege.

The concept of free expression is changing as we pass from the modern to the postmodern. Having the right to free expression is something entirely different than having the affordance of expression. Just as technology challenged exclusive control of knowledge in the fifteenth century, exclusive control of information is challenged again today, this time by the Internet. On the Internet, there is no central control: no editorial board to determine acceptability, no screening committee to determine relevance, no financial board to assess marketability. Each author is her own publisher. Each reader, his own editor. All that is required for publication on the World Wide Web is a personal computer, a modem, and a user account on an Internet server. Students and faculty enjoy such affordance at most major universities. Commercial providers offer public access at at costs comparable to telephone rates. Public schools are on the World Wide Web, publishing hypertext productions by teachers and students. Today a third grader has the same affordance for expression as any other netizen, be they politicians, professors or published authors. What's more, her physical youth can be masked by her abilities of expression, making her a virtual equal among adult netizens (Fishman & Pea, 1993).

During the past decade, constructivist researchers have stressed the importance of anchoring instruction to genuine tasks in situated contexts (Cognition and Technology Group at Vanderbilt, 1992)(Brown, Collins, and Duguid,1989)(Resnick, 1987)(Jonassen and Duffy, 1992). The Internet offers countless affordances toward that instructional goal. Consider a seventh grade class learning English grammar, spelling and rhetoric. Consider the World Wide Web as an affordance. Imagine the possibility of our students providing a web page that is a genuine service to the Internet community, something the students care about, and something that is needed. Consider a likely niche, such as a weekly review of children's television, a computer help system for low-tech parents, a FAQ database on snow boarding, roller

blading, etc.. Writing for an audience of peers around the world is likely to elicit motivations that go beyond teacher expectations. To the extent that students use the opportunity to present themselves before a world wide audience their writing will be influenced by motivations of ethos, style, and delivery: the elements of classical rhetoric. The constraining factors are likely to include the teacher's comfort level with the technology, and her willingness to yield control of the resource to her students, the level of her perception about the Internet as an affordance for learning goals (not necessarily for other institutional goals).

The affordance of world wide public expression is something new for all of us. With the Internet, the perceived capability of self expression in a world-wide forum can be extended realistically to the common person. However, there is no expectation that each person will embrace it. Consider Socrates' reaction to literacy. Consider the skepticism of most Americans, saturated with the hype of technology and media. By definition, an affordance is the the potential for action. This implies that there is a will toward specific action. Implied in the affordance is the intentional desire for action and the recognition that the object can enable one's intentions(4).

Quality Control

For the reader, a fundamental constraint has to do with the accuracy, veracity and reliability of online information. This is not to say that accurate information can't be found on the net. The implication has more to do with the shifting role of the reader in assessing the accuracy, validity and applicability of materials which were heretofore left to editors, experts and peer professionals (Ryder, 1995), (Eco, 1979), (Landow, 1994), (Kelly, 1995). An additional skill will be essential to our basic education-- the skill of abductive logic (Peirce, 1902) (Shank, 1994). The goal in abductive logic is not ultimate truth. It is the ability to advance one's inquiry. Abductive logic is the logic of signs: the ability to extract meaning from a given set of circumstances and then to adjust one's inquiry as new information unfolds. The skill of Sherlock Holmes is critical skill of the information age.

There are Internet tools to assist in this process. They are called robots or agents. An agent is a software tool that is dispatched to accomplish a specific task. As information continues to abound on the Internet, we will need such tools to assist us in our searches. The standard tools are search engines which accept a set of keywords from a user and return a list of resources in rank order, listing first those which best match the search criteria. The problem is that searching on a single word can yield overwhelming and debilitating results (Eco, 1995). Stone (1995) suggests that the ideal model for an agent is the graduate student. Graduate students are trained to do research. They can assess the usefulness of new information within in the context of the present inquiry. A research assistant is attuned to a professor's work, and is able to gather the kind of information that fits a given research project. Can software agents be designed to fit that model? So-called intelligent search applications are available today. Instead of submitting a simple keyword, phrase or boolean expression, the user can submit a complex object: a bibliography, a list, an index, an article. The intelligent agent discards incidental and common words from the text object, prioritizes the remaining words by the frequency of use. Multiple searches ensue, and results are evaluated against the model object. Tools of this nature produce quality results for minimal time investment, overcoming the debilitating constraints of too much information associated with simple searches.

The fundamental characteristic of the Internet is that it cannot be controlled. While local legislation can influence pockets of control, the Internet is a world wide phenomenon, with no one in charge, (with everyone in charge). The Internet is not the McGuffy Reader. In more modern times educators could easily control what their students read and direct how those tender minds might be shaped. The educator's role was largely in the selection of good and proper literature, selecting resources which combined intellectual development with moral edification. The learner's moral edification was directed externally by a teacher, by an editorial committee, or by a school board.

Today the classics of literature, fine essays and poetry still abound. They are rapidly finding their way online. There will be a time in the next ten or fifteen years when every essay or poem that was ever published by McGuffy or any other reputable source will be available in digital format for readers who wish to partake of these edifying materials. But along side such uplifting literature will be objectionable material, countless resources of questionable value, some resources of objectionable content. The supreme difficulty in the Information Age will be the ability to restrict a learner's education to a "sanctioned" body of literature. The discipline required of learners in the postmodern age goes beyond that of all previous generations. The role of education in the age of information will be the development of disciplined readers,

skilled in the art of abductive logic. Since we can no longer filter and select proper materials for our students, our highest calling as educators will be to support students in developing such discipline for themselves.

Whitehead (1929) explained to an earlier generation of teachers that, "discipline is knowledge in the presence of freedom". Giving students the freedom to choose, then supporting them through the anguish of moral and logical choices, this is practice that builds discipline, skill, and moral fortitude. It will be the highest, most valued instructional model for the next few decades.

Summary

In contemplating what the future might hold for education it is sometimes useful to gaze into the past. We have attempted to show how formal knowledge broke free from cloistered protection to broad dissemination in the age of Guttenberg. Knowledge in the the modern period followed logocentric patterns with one-to-many relationships. The postmodern period promises yet greater dissemination marked by a many-to-many relationships. The developments brought about by technology allow for new possibilities. We are seeing trends in education toward distributed, collaborative models of learning. Agency is shifting from center to periphery, from teacher to learner, from author to reader, from librarian to researcher, from curriculum to context. The affordances of public expression have exploded, allowing any school child to represent herself before a world-wide community of learners (5). The affordances of information retrieval have advanced to the point where a simple query can yield a flood of information.

This is where the modern and postmodern minds collide. To the modern mind, there is too much information. The world is exploding with ideas and perspectives that cannot possibly be consumed. We must control what people read so that truth might prevail over misinformation, so that quality might prevail over mediocrity, so that correct ideas might prevail over anarchy. But to the postmodern mind, attempts to control information are futile and naive. What control exists in the postmodern world will emerge -- not from the center, but from the periphery. The genie is out of the bottle. There is no chance of forcing him back. Modern educators have learned how to utilize constraints of the environment as a means of scaffolding in the instructional process. Constraints can limit a field of information, making it more manageable for learners. Constraints of grammar and syntax are necessary for language acquisition. General social behavior is learned from constraints involving etiquette and protocol. We have shown that the Internet overcomes many of the constraints imposed by traditional educational infrastructures. But the freedoms that suddenly emerge are frightening. The modern educator might be tempted to impose artificial constraints on the medium in order to control and manage the educational environment. Software is available at this moment which allows a teacher or parent to filter information and restrict access to objectionable sources on the net. We acknowledge that such artificially imposed constraints may be necessary in the short run to mitigate controversial dilemmas and situations that challenge traditional thinking. But we are persuaded that the real challenge for education is to discover the natural constraints associated with a highly connected and deeply fragmented world. A set of rules or policy guidebook for the postmodern will not be found. But out of distributed knowledge, we are seeing the emergence of a new ethic with an entailing structure of distributed control. The challenge for the postmodern educator is to discover the capabilities and natural constraints associated with distributed pedagogy for scaffolding learners in the age of information.

This paper is available in hypertext:

http://www.cudenver.edu/~mryder/aect_96.html

Notes

(1) Given the fact that Socrates' words placed him in disfavor with the authorities of the time, his reluctance to commit those words to writing is understandable.

(2) Oddly, that mode of information transfer prevails in universities to this day.

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(3) Booklearning was obviously not the only form of education. The most common mode of education in the middle ages was neither literate nor oral, it was situated in everyday practice (Lave and Wenger, 1991).

(4) There is, perhaps, another constraining factor associated with a newly gained freedom: fear. In his study of education among third world peoples, Paulo Freire (1993) observed a natural reluctance among prior victims of social oppression to embrace newly gained freedoms. Freiere describes a confusing behavior among many enfranchised citizens as they enter the historical process as responsible participants in society. That fear is often camouflaged in the form of incredulous defense of the old order.

(5) A Department of Education survey shows the number of schools linked to the Internet in early 1996 is approaching 50% and the number of schools involved in accessing the Internet is up 35% from the previous year. (Miami Herald 19 Feb 96 p25)

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